A New Fresh-water Nemertine from Japan

(*Stichostemma grandis*).

By

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With Plate IV.

On March 29th, 1909, in the Botanic Garden of the Hiroshima Normal School, I have casually discovered a small worm of a leech-like appearance, living in the soft water-covered mud in a vessel which was planted with the aquatic plant *Lisichiton kamtschatense* Schott. When first dug out, it was found entirely contracted within its own mucous secreta, but a little later it cast off the latter and began to creep about, meanwhile unmistakably revealing itself to be a nemertine. Subsequent searches enabled me to obtain about sixty specimens out of the same vessel. The discovery seemed to be of much interest, for, to my knowledge, there previously existed no record of the occurrence of a fresh-water nemertine in Japan, a belief which is shared also by Mr. Takakura of Tokyo, who has long been engaged in the study of Japanese nemertines. Moreover, from subsequent study, it turned out that the nemertine represented a hitherto undescribed species of *Stichostemma*. I propose to call it *S. grandis*. The worms, which were kept in captivity, began to spawn on April 19th, and continued to do so till the end of June, when I had to leave Hiroshima. Then, all the material on hand—both the adults and the eggs—were preserved and placed in storage for future investigation.

Later, in the Zoological Laboratory of the University of Cambridge, England, I was able to take up the study of the above material. As the result, I have found some new points of interest in the anatomy and histology to be added to the excellent contributions previously made by Montgomery and Böhmig to the knowledge of *Stichostemma* species. As regards the embryology, the limited supply of the material necessarily made my observations very fragmentary. The shortage was especially felt in dealing with the question of cell lineage, a complete study of which seemed to promise very desirable results of high importance. I will now briefly describe the new species with respect to its external and internal organization, and then give what observations I could make regarding its life-habits and the segmentation of the eggs.

Stichostemma grandis n. sp.

External characters.

The worms (fig. 1, Plate IV), when freed from the mucous coat and fully stretched, measure 25-35 *mm.* in length and 1 *mm.* in breadth. The head end is rounded and somewhat broader than the tail end. The eyes in the adults always number six, forming three pairs. As in other species of *Stichostemma*, the anterior pair are the largest and the posterior pair the smallest, and the distance between the first and second pairs is slightly longer than that between the second and third. The relative position of the three pairs of eyes may well be understood from fig. 2, which represents the anterior end of a young and rather transparent individual 4 *mm.* long. In such a young individual all the organs lying on the surface of head are fairly distinctly visible in surface view. Thus, the paired cephalic grooves (*c. v.*), which appear like two comparatively deep and strongly ciliated pits, are seen situated close but ventrally to the lateral margin and just in front of the second pair of eyes. The rhyncho-stomodæal opening (*r. s.*) may also be distinctly seen as a small despression situated slightly ventral to the tip of head. Besides these, there are always to be recognized, though indistinctly in the adult, two conspicuous marginal constrictions (*m. c.*) lying a short way behind the dorsal ganglia (*d. g.*) and reaching to some extent the dorsal side of body.

The adult (fig. 1) always shows a bright yellowish red colour which becomes gradually fainter towards both extremities of the body. For a comparatively long period after hatching, the young are simply milky white; as in *Stichostemma gracense* when grown to a length of 2–3 *mm.*, they acquire a light rosy-red colour. In later stages of growth, the red colour becomes gradually deeper, and at the same time there occurs a new deposition of a dark-green pigment in the form of finely granular spots. These spots increase in number, becoming more and more closely distributed, until the worm attains a length of about 10 *mm.* Thenceforth, while the red continues to deepen, the green pigments become on the contrary fainter and fainter, finally to disappear altogether when the animal is about 15 *mm.* long. In sexually mature individuals there are two longitudinal series, one on each side, of small roundish markings of an ochre-yellow colour (indicated in fig. 1). They are due simply to the presence of mature gonads, each containing several eggs of a yellowish colour.

Even in the fresh state, the proboscis can be detected through the skin as a narrow opaque streak running posteriorly for about three-fifths of the body-length (see fig. 1). Of course, this apparent length does not cover the actual extent of the whole organ, since the rhynchocoel, when traced by means of sections, are found to extend as far back as the beginning of the posterior one-third of the body.

The entire surface of the worm is uniformly ciliated. Sensory spines, such as occur in *Stichostemma gracense*,[1] are not present.

Internal characters.

The stomodæum and the rhynchodæum are united into a common spacious cavity, the stomo-rhynchodæum, which opens to the exterior at a position slightly ventral to the extreme tip of head. The true mouth leads posteriorly into the œsophagus, which is followed by the stomach, the pyloricus, and the intestine successively. From the dorso-lateral corners of the pyloricus there arise two long anteriorly directed cæca (*cc.*, fig. 3), which reach up to the brain (*dg.* and *vg.*). These cæca seem to be structurally identical with the intestinal cæca, which occur along the entire length of the intestine and number about 90 on each side.

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[1] Böhmig, L., Beiträge zur Anatomie und Histologie der Nemertinen (*St. gracense* Böhmig, *Geonemertes chalicophora* Graff). Zeitschr. f. Wiss. Zool., Bd. 64, 1898.

As before indicated, the rhynchocœl may correspond in its range approximately to two-thirds of the body-length. This is the case with the adult. But in the younger specimens, say in those just hatched, the cavity is relatively much longer, occupying about nine-tenths of the body-length. As the growth advances, the rhynchocœl also grows in length, but somewhat more slowly than the entire body; so that, at a stage when the latter has attained a length of 10 *mm.*, the former is about four-fifths as long, and finally in full-grown individuals its length is equal to about two-thirds of the body-length.

As to the morphology of the proboscis-stylets (chief and accessory) and of the stylet-sac, the present species more nearly agrees with the description given by Böhmig from *Stichostemma gracense* than that by Montgomery from *St. eilhardi.*[1] One point worth mentioning is the fact that, so far as my observations go, the number of accessory stylets in each sac or "acanthocyst" is 3.

One peculiarity of the present species consists in the fact that the proboscis-nerves are not definitely fixed in number, being either 9 or 10 according to individuals. I have not examined enough specimens to be able to decide which of the numbers is the predominant. Nevertheless, it may safely be stated that this variation in number is not due to secondary separation or coalescence of the nerves.

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[1] Montgomery, T. H., *Stichostemma Eilhardi* nov. gen., nov. sp. Zeitschr. f. Wiss. Zool., Bd. 59, 1895.

As to histological characters of the frontal and cephalic organs, I have found nothing peculiar to the present species. The same may be said of the central nervous system and also of the number and distribution of the cephalic nerves. Only there exists a not unimportant point of deviation from Böhmig's description for *St. gracense*, with respect to the origin of that cephalic nerve which distributes itself to the cephalic organ. According to him, the nerve in question originates from the frontal surface of the dorsal ganglion. This is decidedly not the case in the present species; here, that nerve arises from about the middle of the posterior surface of the said ganglion and turns round the outer ventral side of it to join the bottom of the cephalic organ.

As was pointed out by Böhmig in *St. gracense*, the lateral nerve-stems contain very fine muscle-fibres imbedded in the substance of the nervous tissue. In contrast to the muscle-fibres being in that species variable in number, they are in the present species so definite in number and position that there are constantly 2 of them to be found in every part of the stem, always lying in the inner dorsal part of the fibrous layer. I have not been able to trace, as Böhmig did, these muscle-fibres passing out of the brain to the proboscis-musculature. It seems to me probable that they do not do so at all but end in the brain.

One word with reference to the vascular system. This in the present species may be said to agree well with that of *St. gracense*. Accordingly, I have found the very same junction between the dorsal and the right lateral vessels as that which was described and figured by Böhmig from *St. gracense*. The junction occurs just behind the dorsal commissure of the brain.

As to the distributional range of the excretory organs, the present species agrees with the others already known. In fact, they are present nearly throughout the whole length of body, extending from in front of the brain to the posterior body-end. I have not yet examined a sufficient number of specimens to be able to give the exact number of external openings of the excretory system. It may however be stated that there exist more than one—very probably three or four—openings on each side.

The number of mature hermaphroditic gonads varies remarkably with the different size of mature worms. As ascertained by rearing up the embryos hatched from eggs, the worms enter early into sexual maturity, even before completely acquiring the characteristic appearance of full-grown individuals. About two months after egg-deposition, I found a number of small individuals which had developed from the eggs, measuring scarcely over 10 *mm.* in length, but already possessing about twenty pairs of fully developed gonads. All these small worms were of a dark green colour, instead of being deep yellowish red as in real adults. That they were precociously mature individuals, is evident from the following facts (see figs. 4 and 5): the parenchymatous tissue (*p. c.*) is on the whole far less developed, the nephridial canals (*neph.*) are less numerously branched, and the wall of alimentary tube (*int.* and *oes.*) less complicated in structure, than in really full-grown individuals. Examining a complete series of sections of one such form, I have found about eighty pairs of gonads, of which about twenty pairs may be said to have been mature and the rest still immature. The mature gonads (see fig. 4) were in general much smaller than those found in full-grown individuals, each of them containing mostly only one and rarely two ripe eggs (*e.* in fig. 4).

In full-grown worms of yellowish red colour, there exist about eighty pairs or more of ripe gonads, each containing three or four egg-cells. These gonads, as also the precociously mature ones, are of essentially the same structure as those described by previous observers from *St. eilhardi* and *St. gracense.* This is also the case with the immature gonads. Only I should emphasize one point with reference to the hermaphroditism. After examining a fair number of the specimens preserved during the breeding season, I have arrived at the conclusion that in the present species both sorts of sex-cells come to maturity almost simultaneously. So long as the egg-cells remain in the earlier stages of growth and are still attached to the gonad-wall, no spermatid or spermatozoon is yet formed and the male elements are represented by a few small masses of spermatogonia or spermatocytes, nearly all of which show division-figures. Of course these cell-masses still lie in the epithelium, mostly in close vicinity of the funnel-shaped mouth of the genital duct. In the eggs, the later phases, during which they reach maximum size and are brought to complete maturity ready for deposition, are indicated: first, by their liberation from the gonad-wall; secondly, by rearrangement of nucleoli from a localized disposition with tendency to accumulate at the ventralmost corner of the germinal vesicle, into a regular peripheral destribution; thirdly, by the development of the two egg-membranes. Nearly simultaneously with, or a little prior to, the processes mentioned above, the spermatids make their first appearance, subsequently to undergo metamorphosis. This metamorphosis takes place in some parts of a gonad a little earlier than the liberation of the eggs, so that in many gonads there are to be seen fully formed free spermatozoa in accompany with eggs which have not yet reached the final maturation-stage. Nevertheless, the interval between the maturing of the male and female elements is never so long as to cause protandric hermaphroditism like that of *St. eilhardi.*

So much for the more important characters of the present species as seen from the systematic point of view. A brief discussion will now follow regarding its systematic relations to the allied forms known.

It will not be necessary to enter into a historical or critical review of fresh-water nemertines, as this has already been thoroughly done by Silliman[1] and more recently by Montgomery (1895) and Böhmig (1898). Setting aside for the present the question of the validity or non-validity of the several species that have hitherto been described by the authors, we will here consider the more important question whether all the known fresh-water nemertines should properly be regarded, as Bürger[1] does, to constitute the single genus *Tetrastemma*, or, as Montgomery and Böhmig believe, to belong to two genera *Tetrastemma* and *Stichostemma*.

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[1] Silliman, W.A., Beobachtungen über Süsswasserturbellarien Nord-Amerikas. Zeitschr. f. Wiss. Zool., Bd. 41, 1885.

The genus *Stichostemma* was first established by Montgomery in 1895, when he described a new fresh-water nemertine from Berlin (*Stichostemma eilhardi*). A year later, the same writer[2] described another new species (*St. asensoriatum*), belonging to the same genus. In 1898 Böhmig redescribed his former *Tetrastemma gracense* as the third species of *Stichostemma* (*St. gracense*). The grounds for erecting that new genus were given by Montgomery[3] in 1897, and the distinction he makes between *Tetrastemma* and *Stichostemma*, which two genera cover all the known fresh-water nemertines, will be clear from a comparison of the diagnoses given by him to each. For *Stichostemma* he gives:

"Eyes variable in number, usually more than 4; 9 nerves in the proboscis; rhynchocœl does not extend to the posterior end of the body; nephridia extending from in front of the brain to the posterior end of the body; protandric, hermaphroditic, oviparous."

And for *Tetrastemma*:

"Eyes not variable in number, either 4 single eyes (the rule), or 4 double eyes (*T. falsum, cruciatum*); 10 nerves in the proboscis; rhynchocœl extends to the posterior end of the body; nephridia not extending posteriorly behind the œsophagus, diœcious, oviparous."

Despite Bürger's disapproval (1895 and 1904) of establishing the the new genus *Stichostemma*, Böhmig adopted Montgomery's view in consideration of important differences between the two genera in question with regard to their excretory organ, their rhynchocoel, and very probably, to their rhyncho-stomodæum and hermaphroditism as well. However, upon finding some incongruous points in Montgomery's definition of *Stichostemma* when applied to the two species, *St. asensoriatum* and *gracense*, Böhmig (1898) has revised the generic diagnosis as follows:

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[1] Bürger, O., Die Nemertinen des Golfes von Neapel *etc* F. u. Fl. d. Golfes von Neapel, 1895. And also in "Das Thierreich," 1904.

[2] Montgomery, T.H., *Stichostemma asensoriatum* n. sp., a Fresh-water Nemertean of Pennsylvania. Zool. Anzeig., Bd. 19, 1896.

[3] Montgomery, T.H., On the Connective tissues and Body-Cavities of the Nemerteans, with Notes on Classification. Zool. Jahrb., Abth. f. Anat. *etc.*, Bd. 10, 1897.

"Augenzahl veränderlich, gewöhnlich mehr als 4; 9 oder 10 Rüsselnerven; das Rhynchocœlom erstreckt sich nicht bis an das Körperende; die Nephridien dehnen sich von der Gegend des Gehirns bis zur hinteren Körperspitze; zwitterig, ovipar."

I take this definition of *Stichostemma* to be excellently drawn up, sharply differentiating, as it does, that genus from the other. No emendation to it is made necessary by the discovery of the new species described in this paper.

On the following page is given a tabular list of the more important characters of the three hitherto known species and of the present new species of *Stichostemma*.

A glance at that table will show that the present species is more closely related to *St. eilhardi* than to any other of the species, and that *St. asensoriatum* takes an isolated position in that it lacks the frontal organ and is provided with an indefinite number of eyes. The relation between the present species and *St. gracense*, in spite of several points of agreement in internal anatomy, seems to be comparatively remote, since the two species differ markedly from each other in size and colour of body, in the presence or absence of sensory spines, in the extent of cephalic glands, *etc.* With respect to the last-named organ, the present species bears a singular resemblance to the otherwise remotely allied member, *St. asensoriatum.* It is also a noticeable fact that the present species shows, as regards the number of proboscis-nerves, an intermediate or transitional relation to the three other species. As already stated in the foregoing description, the said nerves number 9 or 10 in the present species, the variation

	Maximum body-length.	Colour.	Frontal organ.	Sensory spines.	Eyes.	Proboscis-nerves.	Cephalic glands.	Gonads.	Hermaphroditism.
St. gracense.	12 *mm.*	Yellowish-brown to reddish brown.	Present.	Present.	6.	10.	Well developed posteriorly, reaching to the brain.	About 35 on each side in the largest individual; 18 of them ripe.	Both sex-cells ripen simultaneously.
St. eilhardi.	14 *mm.*	Reddish yellow.	Present.	Wanting.	6.	9.	Well developed, nearly reaching to the brain.	42 on each side in a full grown individual; all ripe.	Protandric.
St. asensoriatum.	18 *mm.*	Bright orange.	Wanting.	Wanting.	Mostly 6; sometimes 5, 7, or 8.	10.	Weakly developed.	?	Protandric.
St. grandis.	35 *mm.*	Bright yellowish red.	Present.	Wanting.	6.	9 or 10.	Posteriorly not extending beyond the level of the second pair of eyes.	About 80 on each side; all ripe.	Both elements ripen simultaneously.

being apparently entirely idiosyncratic. It is, of course, a well known fact that the number of proboscis-nerves is in many other groups of nemertines variable to some extent even in one and the same species; consequently, it cannot be much utilized for systematic purpose. This seems however not to apply to the three hitherto known species of *Stichostemma*, in which the number is definitely known to be either 9 or 10. This fact has induced me to regard the indefiniteness in the number of proboscis-nerves in the present species as one point of its specific peculiarities.

Lastly, the remarkably large size of the present species deserves special mention, as this seems to be correlated with several important characters of the species, for instance, with the unusually large number of mature gonads, with the comparatively short extent of the rhynchocoel, *etc.* From what I have described in a previous paragraph, it will readily be seen that the characteristic points just referred to undergo more or less remarkable changes, according to certain stages of growth, even after the animals have actually entered into sexual maturity. While the maturing gonads increase in number as the animals grow larger, the cephalic glands and the rhydchocoel tend to become reduced in their relative range of extent. So that, if the worms in widely different stages of growth be obtained from different localities, it would be more or less puzzling to determine whether or not they should be brought under the same species. It is interesting to notice that the four species, if arranged in the order of their body-lengths, as they are in the foregoing table, seem to show between them certain relations similar to those which I have pointed out in the present species with reference to different stages of its individual growth on the one hand, and the number of mature gonads and the relative extent of cephalic glands on the other. If this idea be correct, an explanation suggests itself why the two such remotely related species as *St. asensoriatum* and the present species show the singular agreement in having cephalic glands of a similarly low development. I think it highly probable that the relative extent of rhynchocoel in the four species also varies inversely with the size of each; that is, it should be of the largest extent in the smallest form, and *vice versa*. But this can not certainly be insisted upon without exact measurements of the organ in all the known species.

The Life-habits.

As to the original habitat of the plant, *Lysichiton kamtschatense*, I have made some inquiries, in view of the possibility that the animals were transported together with the plant from somewhere to the garden. But I could receive no satisfactory information, except that the plant is a form indigenous in Hokkaidō as well as in some parts in the north of the Main Island or Honshū. Anyway, it seems certain that this Japanese species of *Stichostemma* belongs to the temperate-subarctic fauna as do also all the known species (*St. eilhardi* from Berlin, *St. asensoriatum* from Pennsylvania, and *St. gracense* from Gratz).

As to the life-habit of the species in the plant-vessel, they were always found buried 1–2 *cm.* deep in the very soft mud and almost always in a contracted state within the mucous secreta,—never found creeping on the bottom, nor swimming in the water. The worms showed a fairly strong tendency to negative heliotropism, so that, when kept in a small vessel, they crept about on the surface of mud during night or early in the morning, but went underneath the mud when bright sun-shine pervaded the room. They are more or less gregarious, as often observed by me in the culture-vessels and in the plant-vessel. Most of the specimens in hand were dug out from among the plant-roots, where they were found crowded together.

The negative heliotropic habit of the worms seems to be directly related with the nocturnal spawning. During nearly 70 days, from the 19th of April to the end of June, I have observed twenty or more cases of spawning but never in the day-time. Judging from the fact that freshly deposited eggs were found in mornings (6 to 8 *a.m.*) always in so early a stage of segmentation as consist of 2 or 4 cells, it may be assumed that the deposition took place before dawn. I should here mention that the eggs segment very slowly, some forty to sixty minutes being required for one complete cell-division in early cleavages.

Individuals of a large size lay 400 to 500 eggs in all. The eggs are found sometimes scattered about without order on the bottom of the vessel, and sometimes in a group, as described by Lebedinsky[1] (1897) for *Tetrastemma vermiculus*, enclosed in a colourless and transparent jelly-like string 4 to 5 *cm.* long and about 2 *mm.* thick. This gelatinous, substance, probably mucin in nature, gradually grows more liquid-like with the lapse of time, and finally, within 48 hours, is thrown off by the developing embryos.

As far as my observations go, the mother worm perishes sooner or later after spawning. Those individuals which have finished spawning can easily be recognized by their loss of the peculiar yellowish markings which were visible before on the dorsal side, by their dirty brownish red colour, and by their showing unevenness of body-surface. In spite of my attempts to keep alive such individuals by feeding they invariably broke up into short pieces within one or two days finally to become totally disintegrated. To my regret I could not ascertain if the same or a similar fate befall the precociously mature worms after spawning.

Lastly I may be allowed to make a few remarks regarding the segmentation of the eggs. As the segmentation of nemertine eggs is but meagrely known to us, I have endeavoured to study the process with the material in hand and, if possible, to make out the origin of mesoderm-cells. To my regret, shortage of material has compelled

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[1] Lebedinsky, J., Beobachtung über die Entwicklungsgeschichte der Nemertinen. Archiv. f. Mikr. Anat., Bd., 49, 1897.

me to give up my studies long before obtaining any hint towards elucidating the question. The segmentation I have been able to follow up only as far as the 64-cell stage, in which no directive cleavage determining the future body-axes has as yet set in. As to the general mode of segmentation, the present case belongs to the perfectly spiral type which prevails in some other nemertines as well as in polyclads, polychaetes, echiuroids and molluscs. The process proceeds to the 28-cell stage in much the same way as was described by E. B. Wilson[1] for *Cerebratulus lacteus* and by Zeleny[2] for *Cerebratulus marginatus*, except in the fact that the first dexiotropic cleavages giving rise to the 8-sell stage are equal instead of being unequal. In the accompaning table is given the order of cell-division up to the 64-cell stage, *dt.* and *lt* being used to denote dexiotropic and laeotropic divisions. The sign = denotes equal division; ⊥ or ⊤, unequal division; and ⫫ or ⫪, markedly unequal division of blastomeres giving rise to the upper or lower larger cells.

As in *Arenicola cristata* studied by Child,[3] the rosette cells ($1a_{111}$, *etc.* in textfigs. I and II) are first formed at the 36-cell stage by remarkably unequal laeotropic divisions of the cells $1a_{11}$, *etc.* of the 32-cell stage into $1a_{111}$ and $1a_{112}$, *etc.* The 44-cell stage is reached by two simultaneous equal and laeotropic divisions of $1a_{21}$, *etc.* and $1a_{22}$, *etc.* of the first quartet into $1a_{211}$ and $1a_{212}$, $1a_{221}$ and $1a_{222}$, *etc. etc.* (see text figures I and II). After that, the 48-cell stage is brought about by equal and laeotropic divisions of $1a_{12}$, *etc.*, which correspond to the intermediate cells of polychaete-eggs, into $1a_{121}$ and $1a_{122}$, *etc.* The cells $1a_{121}$, *etc.* are situated each at the apex of the cross-figure formed by the rosette cells ($1a_{111}$ *etc.*). A remarkably unequal cleavage is seen in

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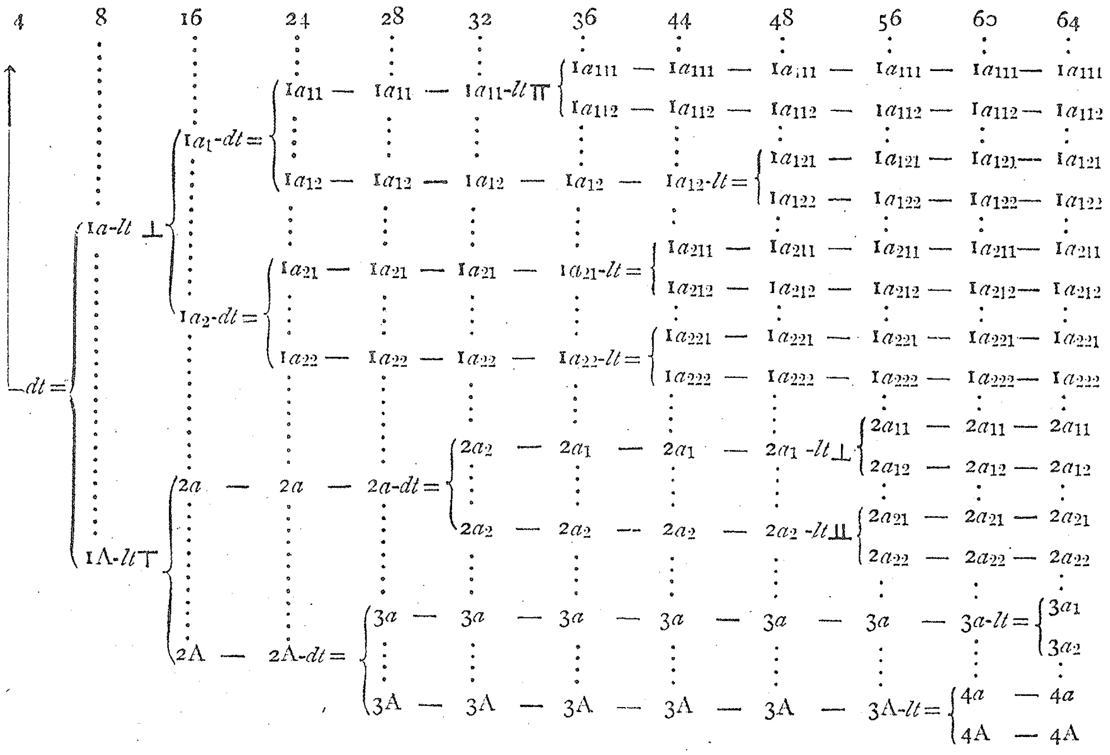
[1] Wilson, E.B., Experiments on Cleavage and Localization in the Nemertine Egg. Arch. f. Entw.-Mech., Bd. 16, 1903.

[2] Zeleny, Ch., Experiments on the Localization of Developmental Factors in the Nemertine Eggs. Journ. Exp. Zool., Vol. 1, 1904.

[3] Child, C.M., The Early Development of *Arenicola* and *Sternaspis*. Arch. f. Entw.-Mech., Bd. 9, 1900.

ORDER OF EGG-CLEAVAGE UP TG 64-CELL STAGE.

STAGES: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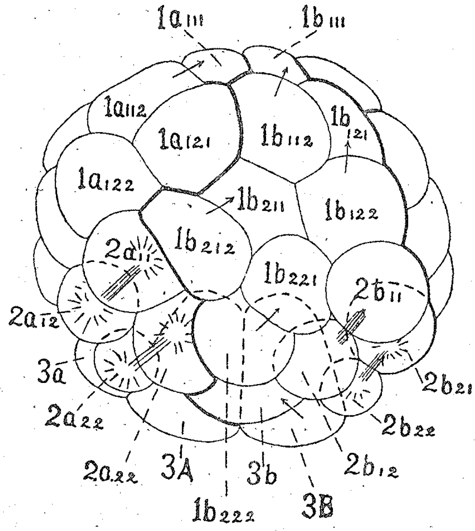
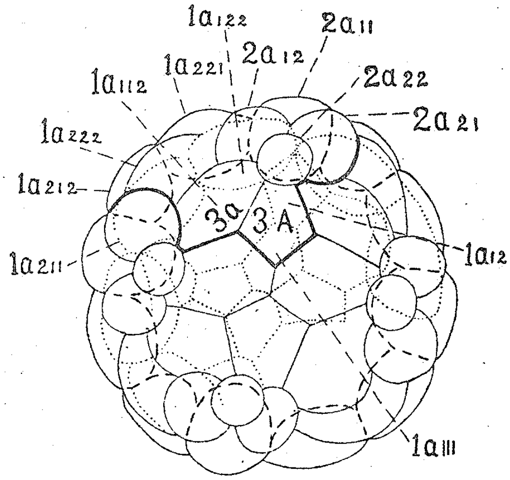


Text fig. I.—Side view of a cleaving egg at the 56-cell stage. About 230 ×.



Text fig. II.—Another egg at the same stage, viewed from the lower pole. Divisions of the second quartet completed. About 160 ×.

the divisions of $2a_2$, *etc.* into $2a_{21}$ and $2a_{22}$, *etc.*, which lead the egg into the 52-cell stage. As this cleavage goes on quite similarly, —e. i. laeotropically—in the four quadrants, there appears no trace of asymmetry to determine the subsequent bilateral symmetry. The stage consisting of 52 cells is rather transient, since the cells $2a_1$, *etc.* very soon follow the above cleavage to divide slightly unequally into $2a_{11}$ and $2a_{12}$, *etc.*

The formation of the fourth quartet ($4a$, *etc.*) takes place at the 56-cell stage, while the first division in the third quartet ($3a$, *etc.* into $3a_1$ and $3a_2$, *etc.*) occurs at the 60-cell stage, thus giving rise to the 64-cell stage. These cleavages are likewise effected by equal and laeotropic division, and accordingly do not give any determination to the future bilateral symmetry. I have observed some eggs consisting of 72 cells. They have probably arisen from the 64-cell stage by dexiotropic division of such cells in the first quartet as $1a_{111}$, *etc.* (the rosette) and $1a_{112}$ *etc.*—the latter corresponding to the stem-cells of the "cross" in polychaete eggs—into $1a_{1111}$ and $1a_{1112}$ etc, $1a_{1121}$ and $1a_{1122}$ *etc.* But I cannot be certain on this point, since I have not actually detected any division-figures causing the supposed cleavages.

To recapitulate, the segmentation-process belongs, as in the case of *Cerebratulus lacteus* observed by Wilson, to a very regular spiral type and shows in its earlier phases no directive cleavage determining the axes of embryo and the origin of mesoderm. As was pointed out by Wilson in his case, the cross formation takes place in the present case also at least not earlier than in the 72-cell stage. Though I cannot make any definite statement about the origin of the mesoderm, yet it seems almost certain to me that Lebedinsky's view of the origin of mesodermal bands from four mother-cells does not hold good in the present case. Here, the mesodermal bands are present in a pair as was observed by Wilson also, and are produced by two large cells which lie symmetrically one on each side of, and near the postero-lateral lip of, the gastral invagination.

In conclusion, I beg to express my sincere thanks to Professor Punnett, Professor of Biology in the University of Cambridge, to whom I owe many kind advices during the execution of this work.

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May, 1911.

Explanation of Plate IV.

Fig. 1. *Stichostemma grandis* n. sp. A large individual, sketched from life, magnified 2 diameters. For the sake of facilitating reproduction, alterations were made in the original coloured drawing in representing red by black and yellow by white.

Fig. 2 Head region of a young animal about 4 *mm.* long. Greatly enlarged. *c. g.*, cephalic groove; *d. g.*, dorsal ganglion; *m. c.*, marginal constrictions behind the brain; *r. s.*, rhycho-stomodaeal opening.

Fig. 3. Anterior parts of a frontal section of head. *c. c.*, pyloric cæca; *c. g.*, cephalic groove; *c. n.*, cephalic nephridia; *pb.*, proboscis (partly protruded); *v. g.*, ventral ganglion. Magnified about 90 diameters.

Fig. 4. Cross-section through the middle region of a small but already mature individual about 10 *mm.* long. *d. v.*, dorsal vessel; *e.*, eggs in the gonads; *g. d.*, genital duct; *int.*, intestine; *int. c.*, intestinal cæca; *l. n.*, lateral nerve; *l. v.*, lateral vessel; *sp.*, spermatozoa in the gonads. Magnified about 90 diameters.

Fig. 5. Cross-section through head of the same individual, passing through the front end of brain. 3*e.*, third left eye-spot; *œs.*, œsophagus; *pb.*, proboscis in rhynchocoel. Magnified about 90 diameters.